

IN THE CLAIMS

Claims 1 and 2 (cancelled).

Claim ¹~~3~~ (previously presented): A graphametric equalizer comprising:

a plurality of equalizing filters spanning a predetermined audio bandwidth;

a data processor;

a data input device in communication with the data processor;

a translation function algorithmic software directing the data processor;

a softening function algorithmic software directing the data processor; and

a data storage unit, wherein discrete center frequency data, discrete bandwidth data and discrete gain data is stored and supplied to the data processor such that the data processor, directed by the translation function algorithmic software, can determine filter parameters using algorithmically defined relationships among the discrete center frequency data, discrete bandwidth data and discrete gain data such that the plurality of equalizing filters can be recharacterized by the filter parameters, and further wherein discrete timing data and discrete incrementing data is stored and supplied to the data processor such that the data processor, directed by the softening function algorithmic software, can determine gain incrementing parameters and timing parameters such that the plurality of equalizing filters can be recharacterized;

wherein each equalizing filter comprises an allpass filter having a multiplier dependent upon a predetermined bandwidth and a predetermined peak gain for a cut region below 0 dB and further dependent solely upon a predetermined bandwidth for a boost region above 0 dB; and

wherein the translation function algorithmic software is configured to approximate the allpass filter multiplier in the cut region below 0 dB and comprises the multiplier approximation function:

$$\beta \approx \tan(\pi BW/F_s)/\log_2(3) \cdot k ; \text{ wherein}$$

β is the allpass filter multiplier, BW is a user selected allpass filter bandwidth, F_s is a user selected sampling frequency, and k is a user selected peak gain of the equalizing filter.

²
Claim ~~4~~ (previously presented): A graphametric equalizer comprising:

a plurality of equalizing filters spanning a predetermined audio bandwidth;

a data processor;

a data input device in communication with the data processor;

a translation function algorithmic software directing the data processor;

a softening function algorithmic software directing the data processor; and

a data storage unit, wherein discrete center frequency data, discrete bandwidth data and discrete gain data is stored and supplied to the data processor such that the data processor, directed by the translation function algorithmic software, can determine filter parameters using algorithmically defined relationships among the discrete center frequency data, discrete bandwidth data and discrete gain data such that the plurality of equalizing filters can be recharacterized by the filter parameters, and further wherein discrete timing data and discrete incrementing data is stored and supplied to the data processor such that the data processor, directed by the softening function algorithmic software, can determine gain incrementing parameters and timing parameters such that the plurality of equalizing filters can be recharacterized;

wherein the translation function algorithmic software is further configured to form a reciprocal estimate for a constant x and comprises the reciprocal estimate function:

$$1/x \approx (1/s) * 2^{-n-2} - r * 2^{-2n-1} + 2^{-n-1} ; \text{ wherein}$$

s is a scaling parameter that will ordinarily have a value between about 0.5 and about 0.6 and is a constant, and wherein the value of n is represented by the most significant digit of the constant x, and further wherein $r = x - 2^n$.

Claim ³~~3~~ (currently amended): A digital graphametric equalizer comprising:

a plurality of equalizing filters spanning a predetermined audio bandwidth, each equalizing filter comprising an allpass filter having a variable multiplier dependent upon a desired bandwidth and a desired peak gain for a cut region below 0 dB and further dependent solely upon a the desired bandwidth for a boost region above 0 dB; and

a translation algorithmic software configured to generate a reciprocal estimate for the desired peak gain k and that comprises the reciprocal estimate function:

$$1/k \approx (1/s) * 2^{-n-2} - r * 2^{-2n-1} + 2^{-n-1} ; \text{ wherein}$$

s is a scaling parameter that will ordinarily have a value between about 0.5 and about 0.6 and is a constant, and wherein the value of n is represented by the most significant digit of the desired peak gain k, and further wherein $r = k - 2^n$.

Claim ⁴~~3~~ (currently amended): The digital graphametric equalizer according to claim ³~~3~~ wherein the translation algorithmic software is further configured to approximate the allpass filter variable multiplier in the cut region below 0 dB and comprises the multiplier approximation function:

$$\beta \approx \tan(\pi BW/F_s) / \log_2(3) \cdot k \text{ for } \tan(\pi BW/F_s) \leq 0.0625 ; \text{ wherein}$$

β is the allpass filter multiplier, BW is a predetermined allpass filter bandwidth, Fs is a sampling frequency, and k is a predetermined peak gain of the equalizing filter.

Claim ⁵7 (previously presented): The graphametric equalizer according to claim ³5 wherein the translation algorithmic software is further configured to approximate the allpass filter variable multiplier in the cut region below 0 dB and comprises the multiplier approximation function:

$$\beta = [\tan(\Omega/2)-1]/[\tan(\Omega/2)+1] \text{ for } \tan(\pi BW/F_s) > 0.0625 ; \text{ wherein}$$

β is the allpass filter multiplier, BW is a predetermined allpass filter bandwidth, Fs is a predetermined sampling frequency, and k is a predetermined peak gain of the equalizing filter.

Claim 8 (cancelled).

Claim ⁶9 (previously presented): A graphametric equalizer comprising:

a plurality of digital equalizing filters spanning a predetermined audio bandwidth, each equalizing filter comprising an allpass filter having a variable multiplier parameter that is dependent upon a desired bandwidth and a desired peak gain for a cut region below 0 dB and further that is dependent solely upon a desired bandwidth for a boost region above 0 dB;

translating means for translating a desired bandwidth and a desired peak gain and generating the variable multiplier parameter such that the plurality of digital equalizing filters can be recharacterized with a desired multiplier; and

softening means for timing user inputs and incrementing filter parameters such that the plurality of digital equalizing filters can be recharacterized,

wherein the translating means comprises an algorithmic software configured to generate a reciprocal estimate for the desired peak gain k using the relationship:

$$1/k \approx (1/s) * 2^{-n-2} - r * 2^{-2n-1} + 2^{-n-1}; \text{ wherein}$$

s is a scaling parameter that will ordinarily have a value between about 0.5 and about 0.6 and is a constant, and wherein the value of n is represented by the most significant digit of the desired peak gain k , and further wherein $r = k - 2^n$.

Claim ⁷~~10~~ (currently amended): The graphametric equalizer according to claim ⁶~~9~~ wherein the translating means further comprises an algorithmic software configured to generate the allpass filter variable multiplier parameter in the cut region below 0 dB and comprises the multiplier approximation function:

$$\beta \approx \tan(\pi BW/F_s) / \log_2(3) \cdot k \text{ for } \tan(\pi BW/F_s) \leq 0.0625; \text{ wherein}$$

β is the allpass filter variable multiplier parameter, BW is a predetermined allpass filter bandwidth, F_s is a predetermined sampling frequency, and k is the peak gain of the equalizing filter.

Claim ⁸~~11~~ (currently amended): A graphametric equalizer comprising:

a plurality of digital equalizing filters spanning a predetermined audio bandwidth, each equalizing filter comprising an allpass filter having a variable multiplier parameter that is dependent upon a ~~the~~ ^a desired bandwidth and a desired peak gain for a cut region below 0 dB and further that is dependent solely upon a desired bandwidth for a boost region above 0 dB;

translating means for translating a desired bandwidth and a desired peak gain and generating the variable multiplier parameter such that the plurality of digital equalizing filters can be recharacterized with a desired multiplier; and

softening means for timing user inputs and incrementing filter parameters such that the plurality of digital equalizing filters can be recharacterized,

wherein the softening means is configured to limit equalizer gain variations to a range of about 0.05 to about 0.06 in linear space no more than once for every 64 samples for a sampling rate of about 44.1 kHz.

Claim ⁹12 (original): The graphametric equalizer according to claim ⁸11 wherein the softening means is further configured to limit equalizer parameter variations to no more than a single modification for every 64 input samples for a sampling rate of about 44.1 kHz.

Claim ¹⁰13 (currently amended): A method of digital equalizer control comprising the steps of:

providing an allpass filter-based equalization filter having a variable parameter multiplier;

receiving a user-selected gain and user-selected bandwidth for an allpass filter associated with the equalization filter;

generating a reciprocal estimate for the user-selected gain using the relationship:

$$1/k \approx (1/s) * 2^{-n-2} - r * 2^{-2n-1} + 2^{-n-1}; \text{ wherein}$$

s is a scaling parameter that will ordinarily have a value between 0.5 and 0.6 and is a constant, and wherein the value of n is represented by the most significant digit of the a desired peak gain k, and further wherein $r = k - 2^n$;

translating the user-selected gain and user-selected bandwidth into a desired first multiplier parameter β for the allpass filter via a multiplier approximation function expressed as:

$\beta \approx \tan(\pi BW/F_s)/\log_2(3) \cdot k$ for $\tan(\pi BW/F_s) \leq$ about 0.0625; wherein

β is the desired first multiplier for the allpass filter multiplier, BW is a predetermined allpass filter bandwidth, F_s is a predetermined sampling frequency, and k is the peak gain of the equalizing filter; and

processing a desired input signal via the allpass filter such that the equalizing filter can achieve a negative gain in a predetermined cut region below 0 dB.

Claim ¹¹~~14~~ (currently amended): The method according to claim ¹⁰~~13~~ further comprising the step of translating the user-selected gain and user-selected bandwidth into a the desired second allpass filter multiplier parameter β for the allpass filter via a multiplier approximation function expressed as:

$\beta = [\tan(\Omega/2) - k]/[\tan(\Omega/2) + k]$; wherein

Ω is the user-selected bandwidth, such that the equalizing filter can achieve a negative gain for a desired input signal in a the predetermined cut region below 0 dB when $\tan(\pi BW/F_s) > 0.0625$.

Claim ¹²~~15~~ (original): The method according to claim ¹⁰~~13~~ further comprising the step of receiving a user-selected center frequency for the equalizing filter associated with the allpass filter and translating the user-selected center frequency into a second variable allpass filter multiplier parameter such that the equalizing filter can be realized via a second-order allpass filter.

Claim ¹³~~16~~ (currently amended): The method according to claim ¹⁰~~13~~ further comprising the step of translating the user-selected bandwidth into a desired allpass filter second multiplier parameter β for the allpass filter via a multiplier approximation function expressed as:

$$\beta = [\tan(\Omega/2)-1]/[\tan(\Omega/2)+1]; \text{ wherein}$$

Ω is the user-selected bandwidth, such that the equalizing filter can achieve a positive gain for a the desired input signal when the input signal is in a predetermined boost region above 0 dB.

Claim ¹⁴~~17~~ (currently amended): A method of digital equalizer control comprising the steps of:

providing an allpass filter-based equalization filter;

receiving a user-selected center frequency, user-selected bandwidth and user-selected gain setting;

generating a reciprocal estimate for the user-selected gain setting;

generating a first allpass filter multiplier parameter in the a region where $\tan(\Omega/2) \leq$ about 0.0625 based in part upon the reciprocal estimate for the user-selected gain setting, where Ω is the user-selected bandwidth;

characterizing an allpass filter via the first allpass filter multiplier parameter, and

processing a predetermined input signal via the equalization filter to achieve a negative gain in a desired cut region below 0 dB.

Claim ¹⁵~~18~~ (currently amended): The method of claim ¹⁴~~17~~ further comprising the steps of:

timing and incrementing the recharacterization of the allpass filter via the first allpass multiplier parameter such that undesirable audible artifacts are substantially reduced.

Claim ¹⁶~~19~~ (currently amended): The method of claim ¹⁴~~17~~ further comprising the steps of:

generating a second allpass filter multiplier parameter in the region where $\tan(\Omega/2) > \text{about } 0.0625$;

further characterizing an second allpass filter via the a second filter multiplier parameter; and

processing a the predetermined input signal via the equalization filter to achieve a negative gain in a the desired cut region below 0 dB.

Claim ¹⁷~~20~~ (currently amended): The method of claim ¹⁶~~19~~ further comprising the steps of:

timing and incrementing the recharacterization of the allpass filter via the second ~~multiplier-parameter~~ allpass filter such that undesirable audible artifacts are substantially reduced.

Claim ¹⁸~~21~~ (currently amended): The method of claim ¹⁴~~17~~ further comprising the steps of:

generating a third allpass filter multiplier parameter based upon the user-selected center frequency;

further characterizing the allpass filter via the third ~~multiplier-parameter~~ allpass filter; and

processing a the predetermined input signal via the equalization filter to achieve a positive gain in a desired boost region above 0 dB.

Claim ¹⁹~~22~~ (currently amended): The method of claim ¹⁸~~21~~ further comprising the steps of:

timing and incrementing the recharacterization of the allpass filter via the filter multiplier parameters such that undesirable audible artifacts are substantially reduced.